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Research Article

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Evaluate and Design the Mini-Hexagon-Shaped Monopole Antenna Controller to Minimize Losses in the Unit

TS Karthik[1]*, NR Dinesh Babu[2], R Raman[3], G Meenakshi Sundaram[4], P Selvaraju[5] and Kukatlapalli Pradeep Kumar[6]

Abstract

Main Aim: Hexagon-shaped mono-pole transmitters are developed, computed, and evaluated in a range of applications. Their whole performance is being compared.

Methods: Various hexagon-shaped mono-pole transmitters are built and modeled using the HFSS. These transmitters are built with Defective Ground Structure (DGS) but include openings in the patch antenna for High-Frequency Spread Spectrum (HFSS), also on the surface, but also. That influence including its position including its slot upon this radiation pattern is examined. Evaluate the modeling, the controller was designed for the broadcast subsystems and respective reflectivity and VSWR have been found.

Findings: The specifications of the antenna is return losses, VSWR, amplification and switching frequency, among other things are assessed as are usually uncertain and VSWR for the manufactured device. The transmissions are continuously monitored. Another most unclear wavelength is around 10 dB among a large bandwidth and that they are less than 10 dB over a specific frequency range. The value of VSWR is less than 2.

Applications: These transmitters may be utilized for wirelessly and interior activities *via* UWB technology.

Keywords: Gains; Hexagon shaped patchwork; Returning loss; Slot module; and UWB

Introduction

To facilitate industrial applications, the Federal Trade Commission allocated a frequency range between 3.1 GHz and 10.6 GHz. When it comes to these operations, monopole antennas are often employed because of their high bandwidth [1]. However, the disadvantage of traditional monopoles is that they are not simple and need a wide input impedance orthogonal to the radiating patch. The results of research into shrinking the size of antennas resulted in the creation of UWB printed electronics that used a partial ground plane many scientists [2] are presently focusing on conventional single ultra-wide bands with perforations mostly in major updates and occasionally potentially perforations mostly in the earth. Due to its excellent connection speed, energy efficiency, easy setup, cost-effectiveness, compact size, low density, and broadband breadth such broadcasters have become extremely prevalent [3–24]. They're getting cheaper.

***Corresponding author:** Karthik TS, Department of Electronics and Communication Engineering, Professor, Aditya College of Engineering and Technology, Surampalem, Andhra Pradesh-533437, India, E-mail: writetotsk@gmail.com

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This influences the generation of energy if a spot is eliminated from the patchwork. The present proportion on the patch antenna changes as a result of changing the slot placement. The lowest operational frequency at which currents produced on the surface of the antenna may travel is dependent on the length of the greatest electrical route that can be traveled. When it comes to attaining UWB properties, the design of the groove and the size of the slot are critical. Generally, the current is generated at the base of the monopole, and even on opposite sides of the monopole's edges. As a result, slots are cut into the bottom margins of the patch, next to the feed line, to enhance UWB parameters. It is also important to note that the bottom layer of the transmitter is a component of the radiating configuration as well as the beam width on the radiating patch. When it comes to obtaining broadband capabilities, the distance between the patch antenna and the patch is essential. It is necessary to utilize a faulty ground construction for UWB characteristics while using a monopole antenna. Bevel slots are cut onto the grounding plane to provide optimal matching and susceptibility bandwidth.

Developers analyze the accuracy of several smallish classifications on UWB hexagonal antenna configurations with microstrip feeds, which are expected to operate in the spectral region 3 GHz-12 GHz.

Variations in patch antenna width and slot measurements are to examine the effects of varying radiation patchwork functionality lengths and slot measurements. A faulty ground construction is used in every instance. Total return loss, VSWR, gain, and switching frequency of various configurations are all measured to compare their performance. The transmitters are developed and tested with the help of the HFSS program.

In addition to modeling as well as assigning tasks, hexagonal transmitters including an L-gap are created and transmission losses are assessed in the lower bug fix and slotted (antenna-1) another with a rectangular form slot in the grounding bug fix and spaces mostly in-plane (antenna-2).

Design of a Hexagon Shaped Monopole Transmitter Antenna

A rectangles patchwork should then be produced, keeping considering careful mind the input impedance, to generate a hexagonally configured magnetic dipole. Afterward, this is converted into something like a broadband transmitter by adding perforations therein. Finally, that use analogous expressions most of which are presented in the next sections, it is converted into yet another hexagonal configuration. Concourse within that paper would be an "L" channel hexagon-shaped aerial, patching openings, and microstrip patch openings. That L-slot, bevel-slots inside this patch and charged particle apertures are required. That the very first commencement node is considered to have been the reflection coefficient of 2.98 GHz.

For Transmitter 2 we have cut a hexagonal antennae patch with a rectangular patch, beveled slots in the patches, and a round slot on the bandpass filter, as well as rectangular slots in the bottom layer or ground plane of the patch. The frequency range of 7.5 GHz has been assessed and transmission signal 2 findings were first examined. The substratum is FR4 thick of 1 mm as well as the dielectric of 4.4, used in this investigation. The transmitters are constructed with the use of formulae that may be found in the literature. It is in this context that the various words have their normal meaning. A description of the antenna structures is provided in Figures 1 and 2.

Ground constructions that are not up to code are utilized in both designs. To decrease the spectral efficiency without compromising the gain, bandwidth, and some other antenna characteristics, different techniques such as utilizing dielectric substrate dielectric substance, applying magnetically inductance waveguide load capacity, and creating slots on the patch are utilized in the majority of cases. PBG structures are utilized to enhance radiation patterns while also reducing the amount of spurious radiation (EGB). The easiest approach, on the other hand, is to make use of faulty ground parts.

Width of the rectangular patch

$$W = \frac{C}{2f_r}\sqrt{\frac{2}{\in r+1}} \quad (1)$$

Effective dielectric constant

$$\in_{eff} = \frac{\in_r +1}{2} + \frac{\in_r -1}{2}\left[1+\frac{12_h}{W}\right]^{-0.5} \quad (2)$$

Different between effective and actual lengths can be estimated from

$$\frac{\Delta L}{h} = 0.412\frac{\left(\in_{eff} +0.3\right)\left(\frac{W}{h}+0.264\right)}{\left(\in_{eff} -0.258\right)\left(\frac{W}{h}+0.8\right)} \quad (3)$$

Length of the patch

$$L = L_{eff} - 2\Delta L \quad (4)$$

Effective length is greater than actual length L due to fringing and it is calculated using the expression

$$L_{eff} = \frac{C}{2f_r\sqrt{\in_{eff}}} \quad (5)$$

Length of the ground plane

$$L_g = \frac{C}{2f_r}\sqrt{\frac{2}{\in_r +1}} \quad (6)$$

Width of the ground plane

$$W_g = \sqrt{3L} \quad (7)$$

2πrh=LW and using relation

$$h = L\sqrt{\in_{eft}} \quad (8)$$

The radius r will be

$$r = \frac{W}{2\pi\sqrt{\in_{eft}}} \quad (9)$$

The side of hexagon is related to radius

$$r^{24}L_p = \frac{4\pi r}{3} \quad (10)$$

$$H = \sqrt{3L_p}; D_p = 2L_p \quad (11)$$

At which parameters H and Dp are as specified Figures 1 and 2. The

Now equating the area of the rectangular patch (L*W) to the surface area of a cylindrical wire of radius r and height h

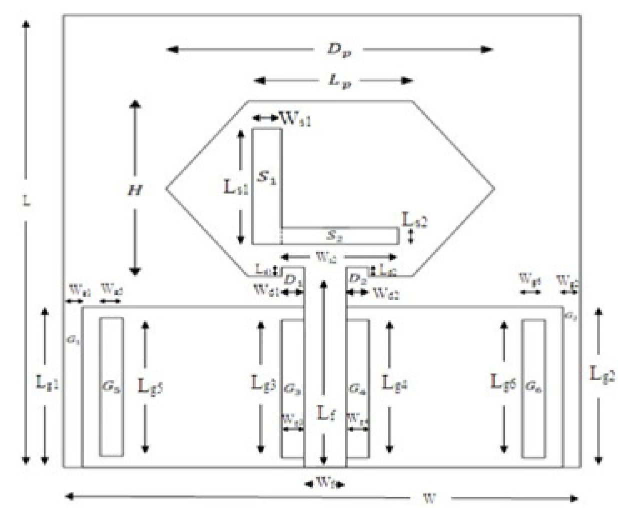


Figure 1: Transmitter architecture 1.

measurements are calculated based on the equations provided above. Both transmitter's design and the findings are shown in the table below. The antennas that were constructed are depicted in Figures 3 and 4. These are the measurements derived from design formulas. The information about the design is shown in Table 1.

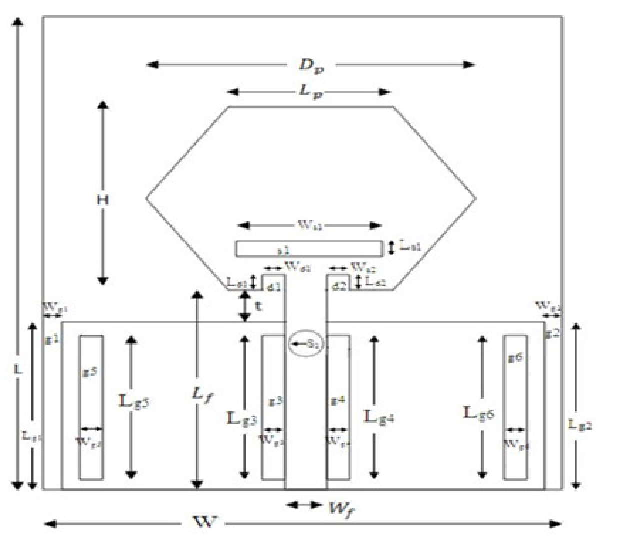


Figure 2: Transmitter architecture 2

Table1: Transceiver 1 and Transceiver 2 characteristics.

Parameter	Antenna 1 dimension in mm	Antenna 2 dimensions in mm
Side length of the patch(Lp)	13	5.437
Diamenter of the monopole elements(DP)	26	10.874
Height of cylindrical monopoles antenna(H)	22.5	9.417
Length of the ground plane(LG)	31	14
Width of the ground palne (Wg)	13	6
Length of the feed line(Lf)	14	9.5
Width of the feed line(Wf)	2.8	2.304
Thickness of the substrate(h)	1.6	1.6
Length of the slot s1(Ls1)	18.5	4.437
Width of the slot S1(Ws1)	2	0.5
Length of slot S2(Ls2)	9	_
Width of the slot S2(Ws2)	2	_
Length of the slot d1(Ld1)	1	0.5
Width of the slot d1(Wd1)	1	0.5
Length of the slot d2(Ld2)	1	0.5
Widtg of the slot d2(Wd2)	1	0.5
Length of the slot g1 and g2(Lg1&g2)	13	6
Width of the slot g1 and g2(Wg1&g2)	2	0.5
Length of the slot g3 and g4(Lg3&g4)	12	5
Length of the slot g3 and g4(Wg3&g4)	1	0.5
Length of the slot g5 and g6(Lg3&g4)	12	5
Length of the slot g5 and g6(wg3&g4)	1	0.5
Spacing between g round plane and patch(s)	0.5	0.5
Resonant frequency	2.98 GHZ	7.5 GHZ
Dilectric constant of a the substract	4.4	4.4
Radius of the circular slot S2	_	1

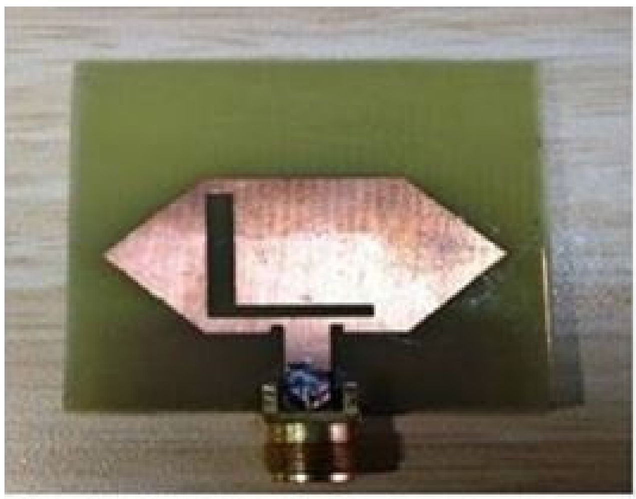
Results

The HFSS program is used to test the transmitters that have been created above. Table 2 indicates the outcomes of the simulation study.

Table 2: Transmitter 1 gain Vs transmitter 1 frequency.

Frequency in GHz	2.98	w3.5	4	5	6	7	8	9	10	11	12	13
Gain in dB	2.15	3.993	5.17	6.61	7.44	7.48	7.66	7.35	6.616	5.16	1.56	-1.836

Antenna 1 is installed in the patch via an “L” shaped slot, and this transmitter is built with the resonance frequency of 2.98×109 Hertz in mind. These findings from the achievement testing that now the recovered inefficiencies are over 10 dB for everyone else in the spectral region (2,98 × 109 Hz-12,98 × 109 Hz), but the total resonant frequency (2.98-12 × 109 Hz) of the numerical simulations shows that the VSWR is below 2. Table 2 illustrates the relationship between gain and frequency.



a

Figure 3: (a) Frontal perspective

b

Figure 3: (b) Lower perspective of the transmitter 1.

a

Figure 4: (a) Frontal aspect

b

Figure 4: (b) Lower aspect

To test the manufactured transmitter return losses and VSWR using a VNA, Antenna 1 is constructed using an FR4 substrate. These findings of the measurements are shown in Figures 5 and 6.

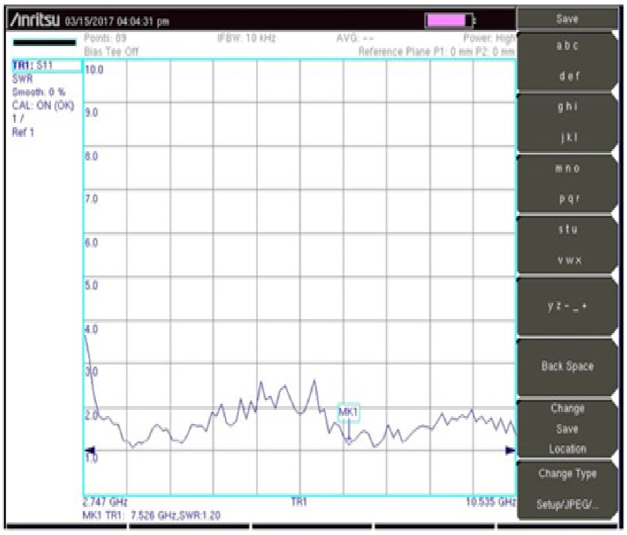


Figure 5: Transceiver 1 VSWR evaluated.

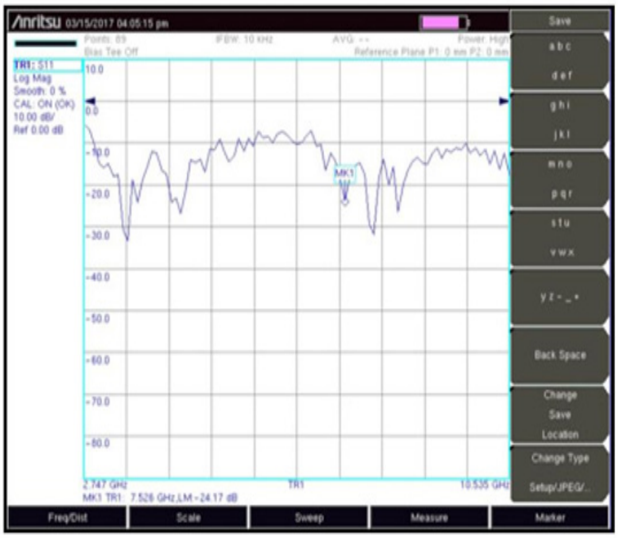


Figure 6: Estimated transceiver 1 insertion loss.

A transmitter with a focus on specific and a preliminary frequency range of 7.5 GHz is configured with a radial slot of radius 1 mm placed on the radiating patch, as well as the effect of its performance compared to the needle tip is investigated to obtain a hexagonal patch with the preliminary harmonic resonance of 7.5 GHz. The findings are shown in Tables 3–5.

Upon on basis of the results, the average efficiency is higher once the circular opening is 4.75 mm from both the entry points. That round opening of a 1 mm radius is affixed at 4.75 mm from the resonant frequency at different locations, with the very same dimensions as the dielectric substrate. Table 4 shows efficacy outcomes only after a 1 mm circumference rectangular gap is broken at different places. These data in Table 4 demonstrate that superior outcomes were obtained so if the triangular opening is 10.5 mm from the transmission line.

Table 3: Modulation of the socket location transmitter characteristic.

Position of the circular slot from feed point in mm	Frequencies GHZ where return loss <10 dB	Frequencies GHZ where VSWR <2	Effciency at 7.5 GHZ
4.75	3to15	2.9 to 15	0.987
5	3 to 15	2.9 to 15	0.9291
5.5	2.9 to 15	2.9 to 15	0.9302
6	2.9 to 10.4, 12.9 to 15	2.9 to 10.8, 12.6 to 15	0.8874
6.5	3 to 11.3, 12.6 to 15	2.9 to 15	0.9006
7	2.9 to 6.4, 8.4 to 9.9, 13 to 15	2.9 to 6.9, 8.2 to 10.5, 12.9 to 15	0.9262
7.5	2.9 to 6.5, 8.6 to 9.5, 13.6 to 15	2.9 to 10, 13.2 to 15	0.922
8	2.9 to 6.4, 13.3 to 15	2.9 to 6.9, 8.4 to 10, 13.2 to 15	0.9091
8.5	3.1 to 6.1, 8.6 to 9.9, 13.4 to 15	3 to 6.6, 8.3 to 9.7, 13.1 to 15	0.997
9	3 to 6.1, 8.7 to 9.6, 13.3 to 15	2.9 to 6.6 ,8.2 to 10.3, 12.9 to 15	0.9429

Table 4: Modulation of rectangle frequency reconfigurable characteristics.

Slot position at a distance feed point in mm	Frequency range (GHZ) over which return lossess higher than 10 dB	Frequency range GHZ over which VSWR is <2	Efficieency at 7.5 GHZ	Directivity 7.5 GHZ
10.5	2.8 to 15	2.7 to 15	0.96341	2.1548
11	2.8, to 7.2,7.9 to 15	2.7 to 15	0.9178	1.8602
11.5	2.8 to 6.9,7.3 to 15	2.8 to 15	0.9254	1.7323
12	2.8 to 6.9,7.3 to 15	2.8 to 6.6, 7.4 to 15	0.9154	1.8256
12.5	2.8 to 15	2.8 to 6.6, 7.4 to 15	0.9339	1.9269
13	2.7 to 15	2.8 to 6.6, 7.4 to 15	0.914	1.7512
13.5	2.8 to 15	2.8 to 6.6, 7.4 to 15	0.8986	1.4939
14	2.8 to 6.6, 7.4 to 15	2.8 to 6.6, 7.4 to 15	0.9206	1.8311
14.5	2.8 to 17	2.8 to 6.6, 7.4 to 16	0.8724	2.099
15	2.8 to 18	2.8 to 6.6, 7.4 to 17	0.9386	1.7794
15.5	2.8 to 19	2.8 to 6.6, 7.4 to 18	0.9075	2.0213
16	2.8 to 15	2.8 to 6.6, 7.4 to 19	0.9153	1.8848
16.5	2.8 to 15	2.8 to 6.6, 7.4 to 20	0.9313	1.6803
17	2.8 to 15	2.8 to 6.6, 7.4 to 21	0.9132	1.8952

Computation is used to determine the gain of Antenna 2 at specific wavelengths, and the results are shown in Table 5. Return losses

Table 5: Transmitter 2 gain Vs. transmitter 2 frequency.

Frequency in GHZ	2.98	4	5	6	7	8	9	10	11	12	13
Gain in dB	1.27	4.37	5.994	7.06	7.7	7.85	7.512	6.698	5.99	4.67	0.8216

are calculated with the VNA (Vector Network Analyzer) for the constructed antenna 2 VSWR, and the findings are presented in Figures 7 and 8, respectively.

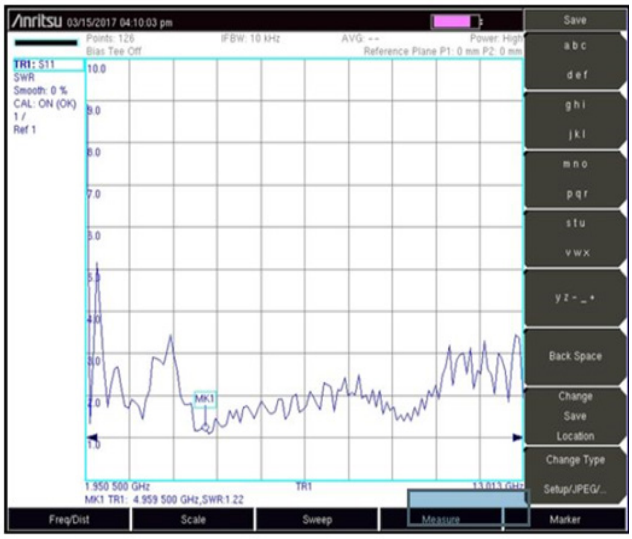


Figure 7: Transceiver 2 observed VSWR.

Discussion

The authors Mandal et al.; Ray; Krishnaveni et al.; Deepthi et al.; Devraj et al. [5–9] have described many distinct hexagonal-shaped mono-pole antennae with the enormous bottom layer and base sizes, and the antenna components have been tested using a variety of various feeding methods.

Figure 8: Estimated attenuation of reception for transmitter 2.

When using a hexagonal-shaped patch with such a side length of 13 mm, it has been found that ultimate gain strength of 4.5 dB may be obtained at 7.5 GHz. Moreover, it has been noted in certain studies that ultimate gain strength of 13.5 db may be obtained with an impedance spectrum ranging from 4 × 109 Hz-14109 Hz. Their results showed maximum amplitude of 7.85 dB or a wavelength of 2.8109 Hz -15109 Hz, even though the measurements were taken in tiny.

Conclusion

Modeled and constructed transmitters featuring hexagonal monopolies, effective evaluated with different natural frequencies have been investigated It was observed that only the needed resonant frequencies may have been attained by utilizing a tiny transmitter. Furthermore, it was revealed that a tiny transmitter is used to assess the efficacy.

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Author Affiliations

Top

[1]Department of Electronics and Communication Engineering, Aditya College of Engineering and Technology, Surampalem, Andhra Pradesh, India

[2]Department of Electronics and Communication Engineering, Aditya Engineering College, Surampalem, Andhra Pradesh, India

[3]Department of Electronics and Communication Engineering, Aditya College of Engineering, Surampalem, Andhra Pradesh, India

[4]Department of Electronics and Communication Engineering, Aditya College of Engineering, Surampalem, Andhra Pradesh, India

[5]Department of Mathematics, Rajalakshmi institute of Technology, Chennai, India

[6]Department of Computer Science and Engineering, Christ University, Kanmanike, Kumbalagodu, Karnataka, India